# DOCUMENTATION OF DECISION-AIDING SOFTWARE:

## EVAL USERS MANUAL

DECISIONS AND DESIGNS INC.

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by

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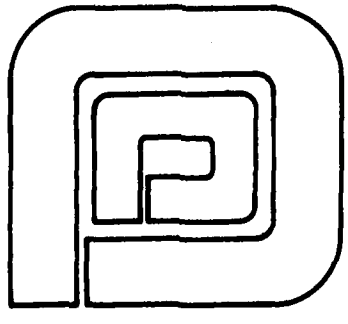

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# EVAL USERS MANUAL

## 1.0 INTRODUCTION

### 1.1 Purpose of the Users Manual

The purpose of this manual is to provide users of the EVAL system with the background material and the detailed instructions necessary to use and interpret the various functions that EVAL provides. The manual also presents the decision-analytic concepts inherent in the EVAL approach, including the assumptions and restrictions concerning its use. The manual includes case study applications.

Because the manual must serve users both skilled and unskilled in the use of decision-analytic methodology, it is prepared in a modular fashion. Thus, whereas the initial sections provide detailed information for the naive user, the last section is direct and unelaborated for those users knowledgeable in the approach.

### 1.2 References


1.2.1 Barclay, Scott, et al. Handbook for Decision Analysis. Technical Report 77-6-30. McLean, Virginia: Decisions and Designs, Inc., September 1977.

1.2.2 Gulick, Roy M. Documentation of Decision-Aiding Software: Introductory Guide. Technical Report TR 79-1-93. McLean, Virginia: Decisions and Designs, Inc., in press.

1.2.3 Allardyce, Linda B.; Amey, Dorothy M.; Feuerwerger, Phillip H.; Gulick, Roy M. Documentation of Decision-Aiding Software: EVAL Functional Description. McLean, Virginia: Decisions and Designs, Inc., November 1979.

1.2.4 Allardyce, Linda B.; Amey, Dorothy M.; Feuerwerger, Phillip H.; Gulick, Roy M. Documentation of Decision-Aiding Software: EVAL System Specification. McLean, Virginia: Decisions and Designs, Inc., November 1979.

## 1.3 Abbreviations and Terms

1.3.1 EVAL - EVAL, the name of the system, is an abbreviation for Evaluation, reflecting the system's major area of applicability.

1.3.2 Terms - Standard mathematical notations and decision-analytic terminology are used throughout this manual. Decision-analytic terms are defined when they are first encountered. Reference 1.2.1 provides more detail on decision analysis, should it be desired.

# 2.0 SYSTEM SUMMARY

## 2.1 Background

Military decision makers and their staffs often must evaluate several alternative future courses of action and choose the one course that appears to be optimal. In most important decision situations that choice is made difficult by two factors: the uncertainty of events and the multiple attributes of the postulated decision outcomes.

Uncertainty manifests itself by the presence of key future events that will eventually impact on the decision but whose manner of unfolding is beyond the control of the decision maker. Examples of such events include weather, political developments, and adversary dispositions.

The second factor concerns the many and diverse goals that characterize most important decision problems and the difficulty the decision maker has in matching the multiple attributes of the various decision outcomes with the multiple criteria for success.

Military decision problems of the type described are common, for example, choosing a contingency evacuation posture or selecting an offensive course of action in the face of uncertainty. Indeed, the various civilian and military intelligence agencies exist to assist the decision maker in assessing the relative likelihoods of future events. Similarly, operational staffs provide expertise in addressing and focusing the various criteria for success.

There are also many important military decision problems in which the decision-making process proceeds under

conditions of relative certainty. In those kinds of situations it can be assumed that the decision maker has, in effect, complete information about the alternative courses of action. There are no key uncertainties to complicate the decision outcome. Decision problems of that kind can be represented graphically by a decision tree drawn in the manner of Figure 2-1.

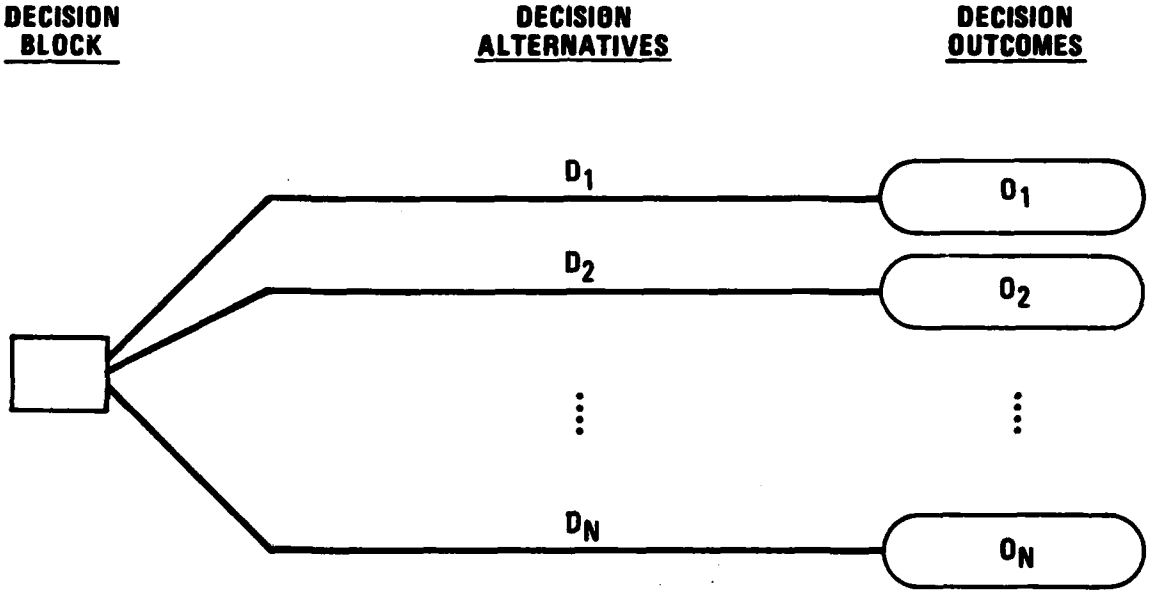


Figure 2-1
**DECISION MAKING UNDER CERTAINTY**

In the figure, choosing alternative $D_1$ leads inexorably to outcome $O_1$, $D_2$ leads to $O_2$, and so forth. The solution is, in theory, deceptively simple: choose the path that leads to the outcome providing the greatest satisfaction to the decision maker. In practice, however, the solution is difficult because there are multiple conflictive criteria for determining satisfaction. Inevitably, there are value

trade-offs that must be made, such as performance versus cost and risk versus yield.

Examples of military decision problems in an environment of relative certainty include design-to-price source selection procedures in which the source selection authority must choose the best item or design from among its equally priced competitors. The criteria comprising what the decision maker believes constitutes a best design could easily number in the hundreds.

Another example is that of crisis decision making: quickly analyzing and choosing among several viable courses of action based on multiple criteria such as the adequacy of forces, command and control arrangements, logistics, simplicity of operations, availability of supporting fires, and so on. Evaluation and selection problems of all kinds, such as personnel selection, promotion, and the assignment of missions to commands, all fall into the classification of decision making under relative certainty.

EVAL is a decision-aiding system designed to help decision makers solve problems of evaluation under relative certainty. EVAL provides a sound structural framework for deliberation, reasoning, and analysis. EVAL aids decision makers by prescribing a straightforward normative procedure for organizing and analyzing difficult decision problems involving complex value trade-offs in the choice of a course of action.

EVAL has its roots in decision analysis, a management discipline that emerged in the 1960's. As described in reference 1.2.1, decision analysis has proven enormously effective in aiding military decision-making processes across a broad spectrum of applications. EVAL, in particular,

has been employed in many source selection and procurement decisions and in the evaluation of military plans.

## 2.2 Objective

EVAL is a decision-analytic based, computer-assisted evaluation strategy. Its primary purpose is to provide decision makers a procedural framework that will ensure that their ultimate decision choice is a coherent one: a choice fully consistent with their own goals and value structures.

EVAL provides a logical evaluation strategy that has several very desirable characteristics. First, EVAL discriminates effectively among the various alternatives being evaluated. Consistent with the decision maker's judgments, EVAL not only produces a rank ordering of the alternatives in terms of their overall utility to the decision maker, but it also scales the alternatives as well, indicating the magnitude of the difference between any two alternatives. Second, EVAL is a reliable strategy, in the sense that the results are reproducible. The specificity and visibility of the model structure are such that, almost without exception, the same results will be produced by the same decision maker working independently over time. Third, the model facilitates understanding. Its structural framework provides clearly defined links between the input data and the output results. Furthermore, EVAL promotes the capture and preservation of the supporting rationale for all value judgments. Finally, the EVAL strategy is an equitable one; its visible structure reduces the likelihood of there being inherent biases in the evaluation procedure.

The fundamental product of EVAL is a computer-stored conceptual representation, or model, of the decision problem at hand. Whereas decision analysis provides the theoretical

background and procedural guidance, EVAL provides the specific methodological tool for processing information and quantitatively evaluating the various alternatives open to the decision maker.

It must be emphasized that the use of decision analysis and EVAL does not replace human judgment; rather, it aids human judgment.

The overall objective of the EVAL system is to provide decision makers with the capability to construct, store, retrieve, exercise, and modify EVAL models of decision problems. The user who is inexperienced in decision analysis is cautioned that the EVAL model should not be applied indiscriminately, nor should its results be interpreted blindly. In particular, the prospective user must understand that the EVAL framework fits only those situations that meet all of the following characteristics.

- The evaluation problem is well formed; i.e., alternative courses of action have been identified.
- Multiple criteria apply to the evaluation of the alternative courses of action.
- There is no future key uncertainty whose outcome will impact the decision choice.
- A linear additive structural representation of the problem will suffice.
- An ad hoc solution is appropriate.

## 2.3 Procedural Overview

The first step in problem solving using EVAL is to construct a conceptual model of the problem at hand. The EVAL software is not used during the initial development of the model; rather, the modeling process should be a discovery process that initially should require several trial constructions using paper and pencil methods. The EVAL system should be used only when the model has reached a more advanced state of refinement.

The EVAL strategy uses multi-attribute utility (MAU) theory as the organizing framework for information processing. MAU assessment is the methodological tool with which the decision maker defines and exercises EVAL models to evaluate alternative systems. The EVAL model is used to quantify and assess the overall relative value of very complex multi-attributed decision alternatives that differ across a large number of characteristics.

The EVAL model is hierarchical in nature, starting with the overall top-level criterion for which a comparative evaluation score is desired. That factor is successively decomposed into its component criteria in descending levels of the hierarchy such that each successive lower-level criterion is more specific than those at the preceding level. At the lowest level of the hierarchy are the criteria for which the user must specify utility scores for each of the alternatives. The criteria at the lowest level address the more easily understood operational or technical attributes of the systems under evaluation.

The format of a typical EVAL MAU model is shown in Figure 2-2. As indicated in the figure, the decision maker must decompose the overall evaluation criterion into its component criteria. Those, in turn, are decomposed into

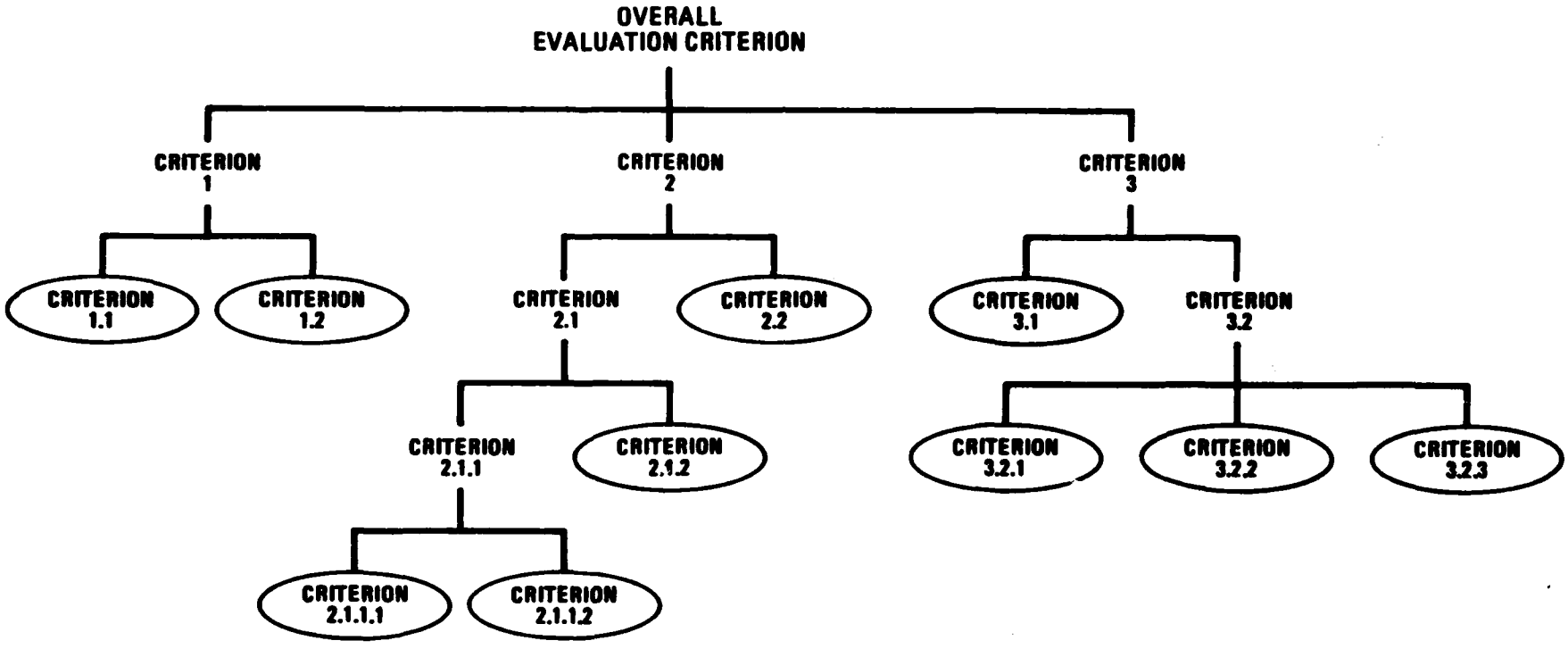


Figure 2-2
THE FORMAT OF A MULTI-ATTRIBUTE UTILITY ASSESSMENT MODEL

their components, and so on successively until, at the bottom level, a criterion is so well defined that there is no need for further decomposition. The bottom-level criteria are circled in the figure.

Once the model becomes a well-structured, adequate representation of the evaluation criteria, the decision maker must make two kinds of value assessments: relative utility scores for the various alternatives and relative importance weights for the various criteria.

For each bottom-level criterion, the decision maker must assess the relative utility provided by each alternative. A utility is a number between zero and one that represents the relative degree of satisfaction to the decision maker of an alternative with respect to a particular bottom-level criterion. Utilities are normally expressed as percentages of complete satisfaction. For example, three alternative systems might be scored 50 100 0 with respect to criterion 2.1.2 in Figure 2-2. The scoring indicates that, relative to only the three alternatives under consideration, the second is the best, the third is the worst, and the first falls midway between the two with respect to that criterion.

Note that utility scores are assessed only at the bottom-level nodes of the structure. For that reason, the bottom-level criteria must be so well defined that the assignment of utility scores to the alternatives is a relatively easy process. That is, the bottom-level criteria should foster the process of discriminating among the alternatives.

Once the utility scores have been assigned for the bottom-level criteria, the decision maker must assign

importance weights to the criteria. That is, with the exception of the bottom-level criteria, each criterion in the structure has subordinate components. The decision maker must assess the relative importance of the components to the aggregate criterion.

A set of importance weights is assigned for each decomposition; one weight for each component. The weights themselves represent percentages of the whole and must sum to 100%. For example, the criteria comprising criterion 3.2 in Figure 2-2 could be assigned unnormalized weights of 50 100 50, which EVAL would normalize to 25 50 25.

Once the model has been completely structured and the utility scores and importance weights specified, it can be exercised by the user to produce the overall top-level utility associated with each of the decision alternatives. The rational user should choose that alternative having the greatest overall utility.

The model can be analyzed with respect to the sensitivity of the implied decision choice to variations in the weights assigned to the criteria. In addition, intermediate values of utility can be obtained at any level in the model.

## 2.4 Purpose of the Model

At this point it must be noted that the purpose of an EVAL model is not to capture reality, but rather to approximate it. Structuring an evaluation model is an art, and the practice of that art is attended by great difficulties in selecting a representative set of criteria and in structuring those criteria. Ideally, an experienced professional decision analyst would work closely with the decision maker in structuring an EVAL model. In any case, the ultimate tests of an EVAL model should be:

a. Is the model free of obvious inconsistencies?

b. Does the model approximate the reality of the situation?

c. Is the model practical and useful to the decision maker?

d. Does the model provide insight to the decision maker and the staff?

# 3.0 STRUCTURING THE EVAL MODEL

In order to use EVAL, the user must first create an EVAL model. To facilitate understanding of the model structuring process, this section uses a hypothetical case study approach.

## 3.1 Hypothetical Case

One of the services is investigating the possibility of consolidating seven separate outmoded missile maintenance and repair facilities located throughout the continental United States. None of the current facilities are capable of accommodating the combined workload, so that an entirely new and modern facility is required. Upon activation of the new facility, the old facilities will be deactivated and closed.

A preliminary study has uncovered five candidate sites for the new facility. Each one of the candidates has a strong appeal on at least one dimension. The decision maker is faced with a dilemma in choosing among the five sites. Accordingly, the decision maker has decided to use EVAL.

## 3.2 The EVAL Model

The first step in using EVAL is to structure an EVAL model. The model is structured criterion-by-criterion from the top down by successively decomposing each criterion in turn until, at the bottom level, a criterion is so well defined that there is no need for further decomposition. The format of the model should resemble the general format shown in Figure 2-2.

Initially the structure of the model will require several iterations and refinements. For that reason, the

first stages of structuring should be done using paper and pencil rather than with the EVAL software.

When the model structure is well formed, the user creates an EVAL model. A complete EVAL model consists of the following elements.

3.2.1 The nature of the evaluation problem - A short label defining the problem. This label distinguishes the EVAL model as a whole and is used by the system to store and retrieve the model. In the case at hand, SITES is an appropriate label.

3.2.2 The systems - A list of the various systems to be evaluated. The term "systems" is used in the generic sense; it could refer to items to be procured, fiscal programs to be funded, personnel to be evaluated, and so on. In the site selection problem the systems to be evaluated are the five sites. They will be referred to hereafter as site A, site B, site C, site D, and site E.

3.2.3 The criteria - A hierarchical set of criteria constituting the overall evaluation. The top-level evaluation criterion is decomposed into its immediate component criteria which themselves may be further decomposed. Those criteria which are not further decomposed constitute the bottom-level criteria.

Each criterion is assigned a data identification number in the manner shown in Figure 2-2. The number describes how all of the various criteria are logically related. For example, criterion 4 would decompose into criteria 4.1, 4.2,...,4.n. Similarly, criterion 4.4 would decompose into criteria 4.4.1, 4.4.2,...,4.4.m. The top-level criterion is usually assigned the data identification

number 0 and its immediately successive criteria assigned the numbers 1, 2, 3...

Figure 3-1 is a representative, although incomplete, structure of the criteria relevant to the site selection problem. Only two bottom-level criteria are shown in the figure; both are circled. The figure is notional; other criteria could be added.

The user should provide concise written definitions of the criteria. Bottom-level criteria, in particular, must be defined precisely since they are the only criteria for which the alternatives will be scored with respect to one another. For example, criterion 1.3.3.1.1 might be defined as "...the total amount of existing covered warehouse storage space including open-sided shed storage."

3.2.4 Utility scores - For each bottom-level criterion, the user must assess the relative utility of each alternative. Utilities must range in value from 100 for that alternative providing the highest degree of satisfaction to 0 for that alternative providing the least satisfaction. Appropriate intermediate values of utility are assigned to the remaining alternatives. Written rationale should support the utility assessments.

It is important to note that the alternatives must be assessed across the full range of value of utility: 0 to 100, inclusive. The overall importance of the difference between the worst (0) and best (100) alternatives will be assessed later, but at this point both values (0 and 100) must be assigned. The purpose of the model is to discriminate among the specified alternatives. That discrimination must be made at each bottom-level criterion.

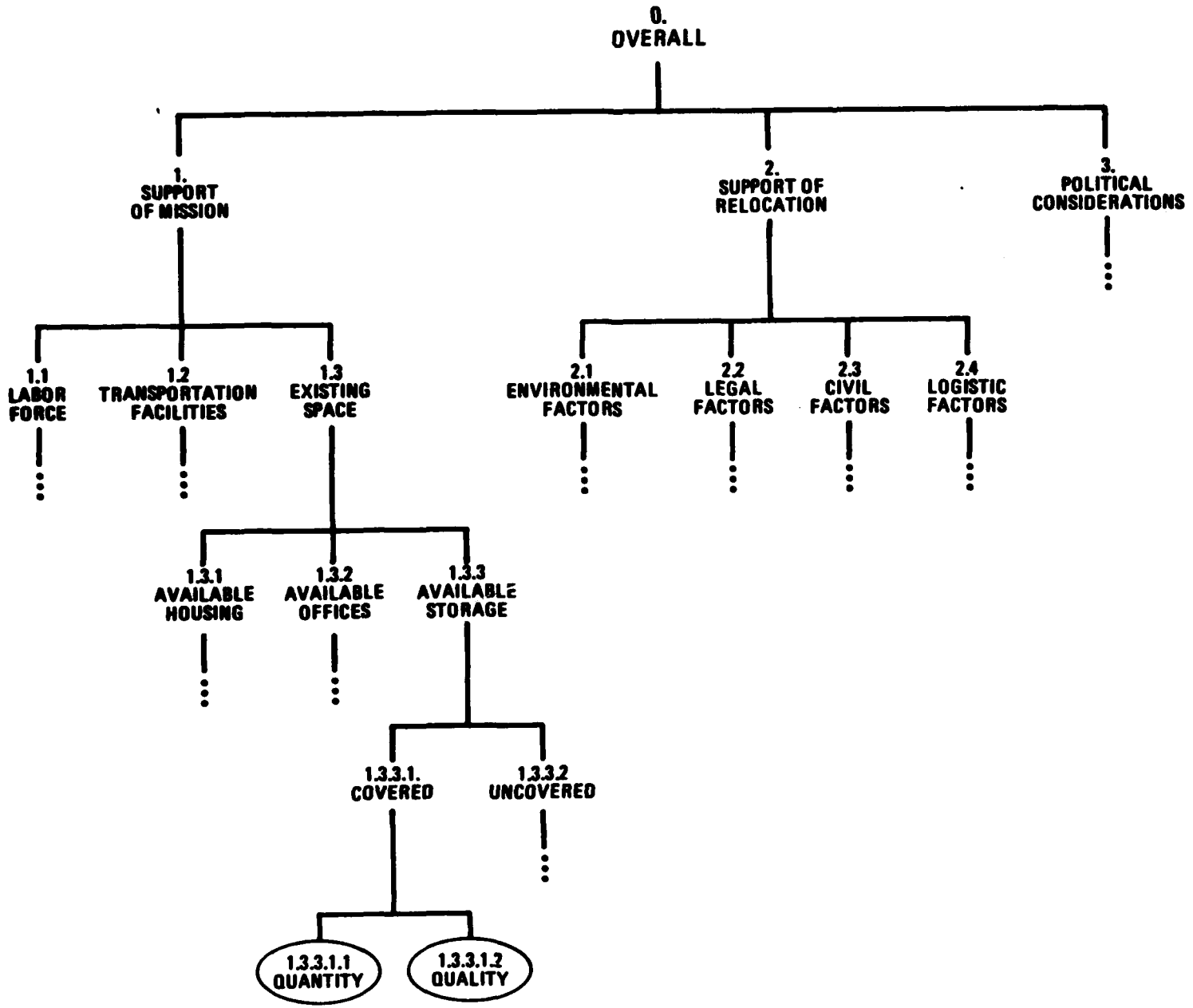


Figure 3-1

INCOMPLETE EVALUATION STRUCTURE

For the site selection case, a representative assessment of utilities is shown in Figure 3-2. Note that a particular value of utility may be assigned to more than one alternative. Again, the user is reminded that written rationale should support each utility assessment.

Criterion 1.3.3.1.2

OVERALL--SUPPORT OF MISSION--EXISTING SPACE--AVAILABLE STORAGE--COVERED--QUALITY

| | | |
|---|---|---|
| SITE A | - | 25 |
| SITE B | - | 0 |
| SITE C | - | 100 |
| SITE D | - | 25 |
| SITE E | - | 90 |

Figure 3-2
REPRESENTATIVE UTILITY VALUES

3.2.5 Criteria importance weights - Proceeding from the bottom-level criteria to the top, the user must assess the relative importance of the decomposed criteria. For example, in the site selection problem the user must determine the relative importance of the quality versus the quantity of available covered storage. That determination should not be based on some global, absolute notion. Rather, the determination must be based on the particular attributes of the sites under consideration. It must be based on the relative difference between the best and worst sites regarding quality and quantity. For example, Figure 3-2 shows that regarding quality, site B is worst and site C is best. Assume that regarding quantity, site A is worst and site E is best. In assessing the relative importance of quality and quantity the user must mentally substitute for quality

the difference between sites B and C and for quantity the difference between sites A and E. Assume that the relative difference in quality is judged four times more important than the relative difference in quantity. Then the most important of those two criteria, quality, would be assigned a weight of 100 versus a weight of 25 assigned to quantity. EVAL would normalize those weights to 80, 20 so that they sum to 100%.

The user proceeds in that fashion, bottom to top, comparing differences until each criterion has been assessed. As the user proceeds toward the top, each criterion is evaluated by using its most important component as a surrogate. For example, using Figure 3-1, in assessing the relative importance of covered versus uncovered storage, the user compares the difference in the quality of covered storage with the difference in the most important factor comprising uncovered storage. Only the bottom-level differences are used in the weighting procedure, each being used to represent a higher level criterion.

In that manner, relative importance weights are assigned to each criterion until, finally, weights are assessed for the relative importance of criterion 1, support of mission; criterion 2, support of relocation; and criterion 3, political consideration. As before, those weights are assessed by comparing the difference existing between the most important bottom-level criterion in each area.

For example, consider the structure shown in Figure 3-3. Assume that the decision maker judges bottom-level criterion 1.2.1 more important than 1.2.2, and criterion 2.1 more important than 2.2 and 2.3. The more important criteria (1.2.1 and 2.1) are shaded in the figure. The next step is to compare criterion 1.1 with 1.2. At that

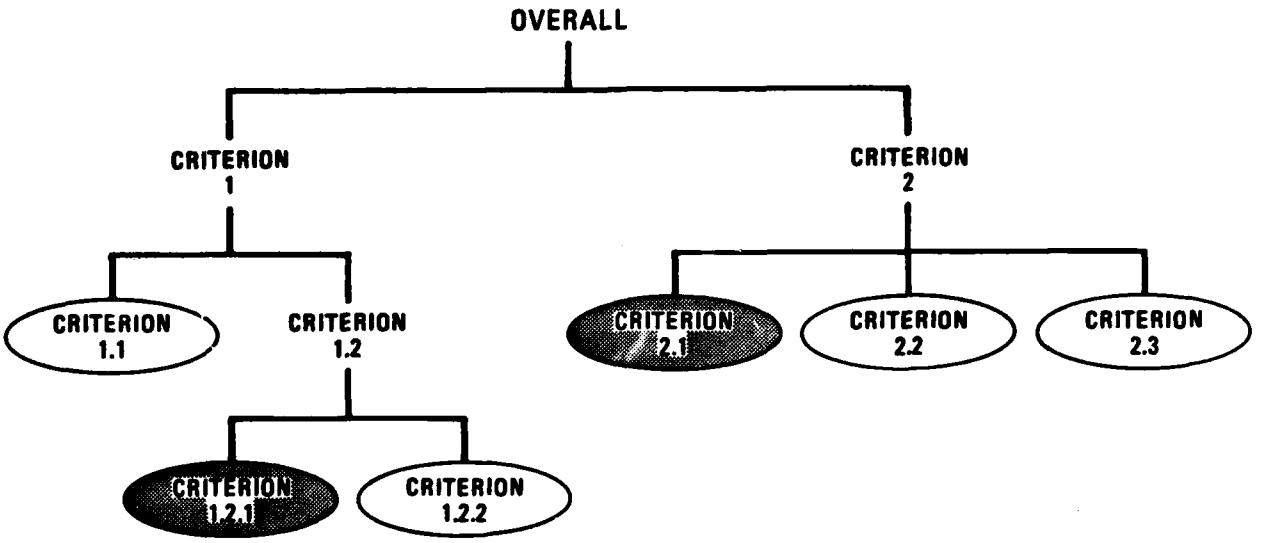


Figure 3-3
**A SAMPLE STRUCTURE**

level, criterion 1.2.1 is used to represent 1.2. The required comparison is between criteria 1.1 and 1.2.1. Again, assume that criterion 1.2.1 is judged most important. Criterion 1.2.1 now becomes a surrogate for criterion 1, where it is compared with criterion 2.1, the surrogate for criterion 2.

It is always the bottom-level criteria that are compared in the process of determining importance weights. In that manner, proceeding from bottom to top, weights are established for all of the criteria in the model. The relative importance weights might be as shown in Figure 3-4.

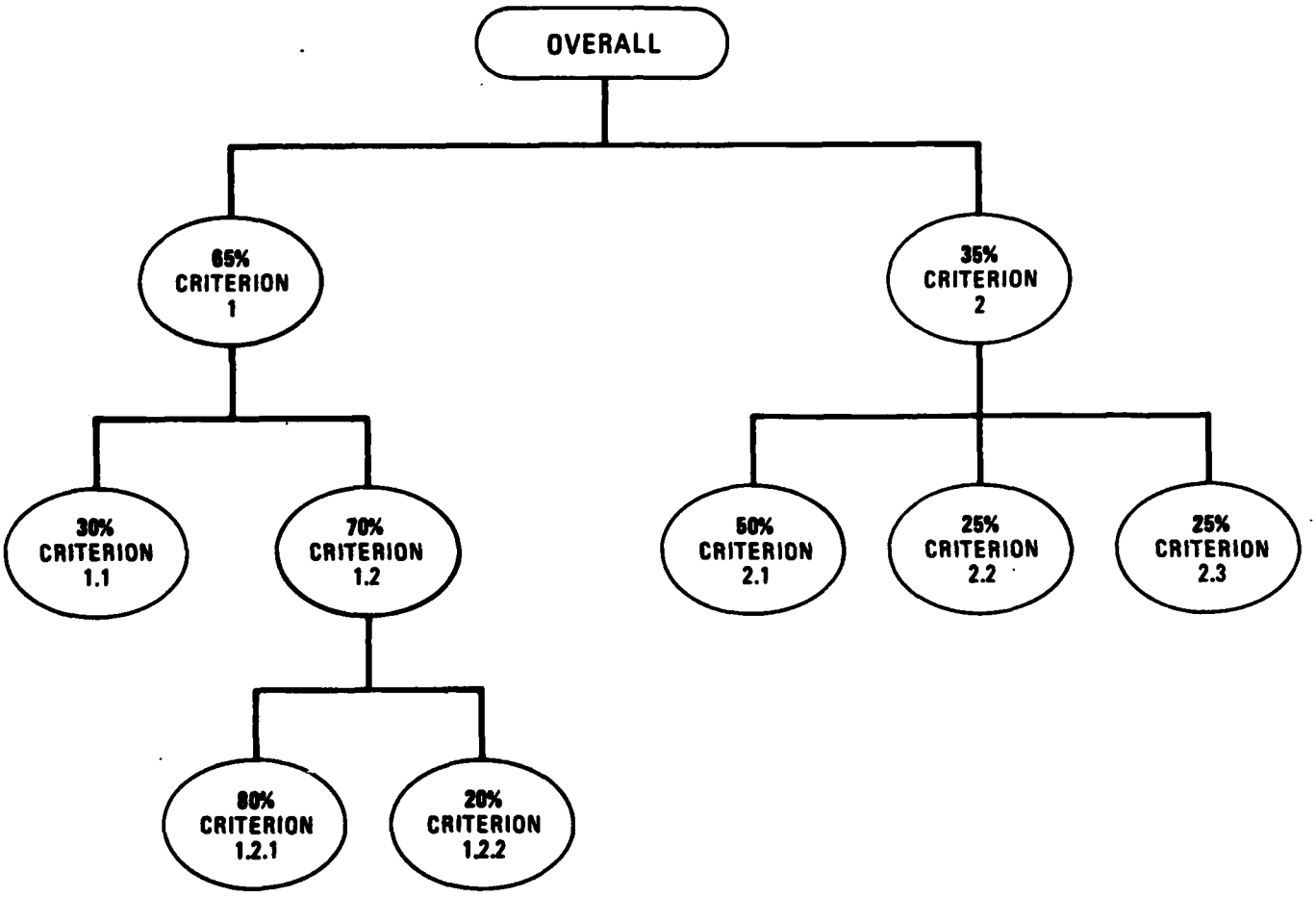


Figure 3-4
**IMPORTANCE WEIGHTS**

An EVAL model has been completely structured when: (1) the systems to be evaluated have been identified; (2) the evaluation criteria are identified, defined, and interrelated; (3) the utility scores for each alternative are assessed at the bottom-level criteria and the supporting rationale for the scores is captured; and (4) the importance weights are assessed for each criterion and the supporting rationale for the weights is captured.

# 4.0 RESULTS OF THE MODEL

Once an EVAL model has been completely specified it can be processed to produce the following results of interest to the user.

## 4.1 Overall Result

EVAL will display the overall utility associated with each alternative. For each alternative the overall utility is computed by properly weighting and adding together the utility scores, beginning with the bottom-level criteria and so continuing to the top of the hierarchy. The utility associated with any one criterion (except those at the bottom-level) is the weighted sum of the utilities at the next lower level. EVAL thus implements a linear additive evaluation procedure.

For example, in the site selection problem discussed in Section 3, the overall result might be as shown in Figure 4-1. The figure displays the utility values of the five sites for each of the successive (next lower level) components as well as each component's relative importance weight (shown in parentheses). The overall utility of each site is shown under the heading "TOTAL." Consistent with the decision maker's values and importance weights, site D should be selected for the new facility.

## 4.2 Intermediate Results

EVAL can display results similar to those shown in Figure 4-1 for any desired criterion other than those at the bottom level. Bottom-level criteria weights and utility scores can be observed by displaying the next higher level

O. OVERALL

| | | | SITE A | SITE B | SITE C | SITE D | SITE E |
|---|---|---|---|---|---|---|---|
| 1. | SUPPORT OF MISSION | (52) | 61 | 72 | 45 | 80 | 75 |
| 2. | SUPPORT OF RELOCATION | (33) | 20 | 62 | 70 | 61 | 38 |
| 3. | POLITICAL CONSIDERATIONS | (15) | 81 | 43 | 52 | 76 | 65 |
| | TOTAL | | 50 | 64 | 54 | 73 | 61 |

Figure 4-1

SAMPLE OVERALL RESULTS

criterion. For example, the two bottom-level criteria shown in Figure 3-1 can be observed by displaying criterion 1.3.3.1, as shown in Figure 4-2. Note that cumulative weights are shown.

Criterion 1.3.3.1

SUPPORT OF MISSION--EXISTING SPACE--AVAILABLE STORAGE--COVERED

| | | | SITE A | SITE B | SITE C | SITE D | SITE E | CUMWT |
|---|---|---|---|---|---|---|---|---|
| 1.3.3.1.1 | QUANTITY | (80) | 0 | 33 | 67 | 100 | 75 | 15 |
| 1.3.3.1.2 | QUALITY | (20) | 25 | 0 | 100 | 25 | 90 | 4 |
| | TOTAL | | 5 | 26 | 74 | 85 | 78 | 19 |

Figure 4-2

INTERMEDIATE RESULTS

## 4.3 Sensitivity Analysis

Variations in the cumulative weights assigned to the various criteria will produce corresponding variations in the overall results. The user should be interested in how sensitive the final results are to such variations. EVAL will perform such a sensitivity analysis.

The user identifies any desired criterion. EVAL then displays the current cumulative weight of that criterion and asks the user to designate minimum and maximum test values of cumulative weight for that criterion. EVAL then varies the cumulative weight from minimum to maximum in ten equal increments, keeping the weights of the other criteria in their proper proportion.

A sample analysis that might be performed in the site selection problem is shown in Figure 4-3. Note that the utility scores that are shown represent the overall (highest level) utility. The highest utility score is identified with an asterisk. The analysis shows that the overall result is indeed sensitive to the weight assigned to the quantity of covered storage. As that criterion becomes more important as its cumulative weight is varied from 0 to 50, site B becomes preferable to site D.

Criterion 1.3.3.1.1

SUPPORT OF MISSION--EXISTING SPACE--AVAILABLE STORAGE--COVERED--QUALITY

Current CUMWT: 15

| WEIGHT | SITE A | SITE B | SITE C | SITE D | SITE E |
|---|---|---|---|---|---|
| 0 | 52 | 61 | 57 | *76 | 58 |
| 5 | 51 | 63 | 56 | *75 | 59 |
| 10 | 50 | 64 | 55 | *75 | 60 |
| 15 | 50 | 64 | 54 | *73 | 61 |
| 20 | 49 | 66 | 53 | *72 | 62 |
| 25 | 48 | 67 | 52 | *70 | 63 |
| 30 | 48 | 69 | 51 | *70 | 65 |
| 35 | 47 | *71 | 50 | 68 | 66 |
| 40 | 45 | *72 | 50 | 67 | 66 |
| 45 | 45 | *74 | 49 | 65 | 67 |
| 50 | 44 | *75 | 48 | 64 | 68 |

Figure 4-3

SAMPLE SENSITIVITY ANALYSIS

# 5.0 TECHNICAL OPERATIONS

EVAL consists of two subsystems: STRUCTURE and RUN. The STRUCTURE subsystem is used to construct a new evaluation model or to edit the structure of an existing model. Its function is solely to specify and relate the hierarchical criteria; it does not elicit utility scores or importance weights.

Utility scores and importance weights are entered by using the RUN subsystem. RUN is also used to edit previously entered scores and weights, and it is used to display the model results as described in Section 4.0.

## 5.1 Option Menus

Both subsystems are hierarchically structured and menu-driven. The user initiates the various subsystem functions by progressing through a hierarchy of menus, each menu presenting several functions to the user. In general, selecting a function either causes a more detailed menu to be displayed or causes the function to be executed. Not choosing any of the menu functions causes the previous menu to be displayed.

## 5.2 The STRUCTURE Subsystem

5.2.1 The primary menu - After the user has loaded the STRUCTURE subsystem into the computer, a primary menu will be displayed. This menu contains eight functions:

- Load Model
- Edit Structure
- Create or Add to a Structure
- Save Model

- o Develop Structure
- o Create Branch
- o Prune Section
- o Print Review Sheet.

In order to use the STRUCTURE software, the user must first select either the "Load Model" function to load an already existing model or the "Create or Add to a Structure" or "Create Branch" functions to create a brand new model.

Load Model - Selecting "Load Model" will cause the subsystem to display the names of the existing models that are available for loading from the model library and will instruct the user on how to load the model into the computer. Once the user has loaded the desired model into the computer, the model is available for editing (the "Edit Structure" option), expanding (the "Create or Add to a Structure" option), contracting (the "Prune Section" option), or reviewing (the "Print Review Sheet" option).

Edit Structure - This function allows the user to edit the name or data identification number (DIN) of any criterion in the model structure. Also, any desired criterion may be deleted from the model.

When "Edit Structure" is selected, the computer responds by requesting the DIN of the desired criterion. When that is specified, the computer displays the DIN and its associated label. The user then either makes whatever changes are desired or, by returning the carriage without entering a change, the user may delete the criterion entirely.

Create or Add to a Structure - This function is used either to create a new model structure or to add to an

existing model which has been loaded using the "Load Model" function. The user is first asked whether the model is a brand new one. If it is, the computer will request the names of the various systems to be evaluated. If not, the previously loaded model is used. In either case, the following procedure is followed.

The computer prompts the user, requesting the DIN and label of whatever criterion node the user wishes to enter. The user types both items on the same line, separated by commas. The criterion numbering scheme is optional, but it is recommended that the user follow the scheme shown in Figure 3-1. Any desired name may be assigned to a criterion, provided that the name does not contain any commas. After each criterion is entered, the computer will display it for the user. If an error is detected, the user may simply retype the name. However, if the DIN is wrong, it can only be corrected by using "Edit Structure."

Instead of responding to the computer's request by entering a new criterion, the user may instead attach an entire branch that was previously created by using the "Create Branch" function. This is done by typing the branch designation character followed by the branch number and the number of the DIN to which the branch should be attached.

Once all criterion nodes and branches have been attached, the user can return to the primary menu by returning the carriage without responding to the computer's prompt.

Develop Structure - In order for a model to be stored permanently in the model library, the model's structure must first be organized into a particular format for internal use. The "Develop Structure" option accomplishes

this. When this option is selected, the computer will display an estimate of the amount of time necessary to develop the structure. When the development has been completed, the computer will inform the user that it is finished. The model can now be stored using the "Save Model" function.

Save Model - The "Save Model" function allows the user to store a newly created or edited model in the computer's library. When the user selects this function, the computer will respond by asking the user to confirm that the structure has been developed using the "Develop Structure" function. A negative response will cause the computer to develop the structure before proceeding. The computer will list the names of the models already stored in the model library. The user is then asked for the name of the model to be saved. If the name proposed by the user duplicates the name of an existing model, the computer will request confirmation that the new model should replace the old one of the same name. If the name is a new one, its name is added to the list of models available and it is saved permanently.

Create Branch - This function is used to create repetitive portions of the model by specifying a single branch. That branch has its own hierarchical organization and can be added to the overall structure at any place it is needed. The user can save a significant amount of time and effort by employing the "Create Branch" function.

When this function is selected, the computer will request the Branch Identification Number. This will be needed later when the branch is added to the overall structure. Each separate branch must be assigned a unique integral Branch Identification Number. The computer will then ask whether the branch is a new branch. The user responds

positively or negatively according to whether an entirely new branch is being created or an existing branch is being edited.

The computer then asks if the format of the branch is symmetric. If the branch is symmetric, the computer simplifies the input elicitation by allowing the user to input at one time the names of all the criterion nodes appearing repetitively at each level. This is done by specifying the number of levels in the branch. The names of the first-level criteria are then typed in, one per line, returning the carriage between nodes. When the carriage is returned without typing anything, the computer asks for the criterion names at the next level. This process continues until all levels have been completed. The computer will then ask for a new Branch Identification Number.

If the branch is asymmetric, the computer will prompt the user to type in each branch DIN and the criterion node name. This process continues until the user returns the carriage without responding. The computer will then request the next Branch Identification Number.

Prune Section - This function allows the user to delete from a structure all nodes emitting from a specified criterion node. This is required if a section of the tree proves inaccurate or unnecessary.

When this function is selected, the user is asked to specify the DIN of the node at which all lower-level nodes are to be deleted. When the user specifies the DIN, the computer displays the name and DIN of the node and requests confirmation that all of the attached nodes should be deleted. Once given confirmation, the computer deletes the appropriate nodes and informs the user of how many nodes

were deleted. It then asks for the DIN of the next deletion. If no additional deletion is required, the user simply returns the carriage without specifying a DIN. Note that the specific node identified with the selected DIN is not itself deleted--only attached nodes are removed.

Print Review Sheet - This function provides the user with a printed record of the nodes (DIN's and criterion names) in the model. This display should be obtained before developing and saving the model to confirm that the model has been properly constructed. When the "Print Review Sheet" function is selected, the computer will instruct the user as to how to obtain the printed copy.

## 5.3 The RUN Subsystem

5.3.1 The primary menu - After the user had loaded the RUN program into the computer, the computer will explain how to load a model from the model library. Once a desired model is loaded, the primary menu is displayed. This menu contains eight functions:

- o Display Results
- o Sensitivity
- o Edit Values
- o Print Results
- o Load Model
- o Save Model
- o New Values
- o Print Data Sheet.

Each of these functions is discussed in the sections which follow.

Display Results - This function allows the user to examine the evaluation results. By specifying a DIN, the user is presented with a matrix showing the total utility at that level of the model for each system being evaluated. The display also shows the utilities at the next-lower level, the relative importance weights of the criteria and their overall cumulative weights.

When the "Display Results" option is selected, the computer will request the DIN of the node of interest to the user. Typing in the appropriate DIN will produce the display described above, followed by a request for the DIN of the next node of interest. Returning the carriage without entering a DIN will return the user to the primary menu.

If the user types the DIN of a node which does not exist, the computer will display a message with that information. If the user types the DIN of a bottom-level node, the computer will display a message informing the user that the requested node is a bottom-level node which cannot be displayed because it has no nodes emitting from it. To view a bottom-level node, the user must select the DIN of the node to which it is attached.

Sensitivity - The "Sensitivity" function permits the user to examine the effect on the overall results of the model caused by changing the weight of any particular criterion in the structure without having to actually edit the previously existing weight. It does this by varying the cumulative weight (the percentage contribution of that particular criterion to the overall result) over a range of values selected by the user.

When the "Sensitivity" function is selected, the computer requests the DIN of the criterion to be examined.

Once that is specified, the computer informs the user of the criterion's current cumulative weight and requests the user to specify the minimum and maximum weights of interest. Once those are specified, the computer will supply the overall utility scores for each of the systems under evaluation in ten intervals between the minimum and maximum weights. Altogether, eleven utility scores will appear for each system, and the system with the highest utility score for each posited cumulative weight will be designated with an asterisk. Returning the carriage will allow the user to designate another DIN for examination.

Edit Values - The "Edit Values" function allows the user to change either the utility scores or the criterion weights. When this function is selected, the user is asked whether it is weights or scores that require editing.

If "Edit Weights" is selected, the user is asked to supply the DIN of the criterion to which are attached the lower-level criteria to be reweighted. The old weights will be shown and the new weights requested. The user may now designate new weights and the computer will automatically normalize them to sum to 100%. The computer requests confirmation of the normalized weights before requesting the next DIN.

If "Edit Scores" is selected, the user is asked to supply the DIN of the bottom-level criterion where the scores are to be edited. The existing scores will then be displayed and the user will be allowed to edit them. If the DIN designated by the user is not a data input node, the computer will display a message informing the user thereof.

Print Results - The "Print Results" function permits the user to obtain a complete printout of the

results for all of the criteria in the model as a permanent record of the evaluation. It is also useful as a means for reviewing the results of a large model containing many criteria, rather than utilizing the more cumbersome and time consuming "Display Results" function.

When "Print Results" is selected, the computer will inform the user how to obtain a printed output from the computer system on which EVAL is implemented. The computer will then allow the user to type in an appropriate and descriptive title for the display. The computer produces a listing of all of the criteria matrices in numerical order by DIN.

Load Model - This function allows the user to select a previously constructed model from the model library and load it into the computer workspace for purposes of display or editing. When the RUN subsystem software is loaded, the computer automatically selects the "Load Model" option because nothing constructive can be accomplished in EVAL before a model is loaded. However, if a user has finished displaying and editing one model, the "Load Model" function may be selected to allow the user to load a second model without having to reload the whole RUN subsystem.

Save Model - This function allows the user to store the current model permanently in the model library. If an existing model has been loaded and displayed but no changes have been made, it is not necessary to save the model.

When the "Save Model" function is selected, the computer will list the names of the models which are currently stored in the model library. The user is then asked for the name of the model to be saved. If the name input by

the user is identical to that of an existing model, the computer will request confirmation that substitution of the new version for the old is desired before it deletes the old version and saves the new one. If the name entered is a new one, the computer saves the model and adds the model's name to the list of available models.

New Values - This function is used to enter a complete set of weights and/or scores into the model. This is normally done only with a newly created model, since the "Edit Values" option is available to make individual changes in weights and scores.

When this function is selected, the user will be presented with another menu requesting that either "Load Scores" or "Load Weights" be selected. Selecting "Load Scores" causes the computer to print out the criteria line-by-line (in order by DIN), awaiting user input of scores whenever a bottom-level criterion is reached. Above this list appears the names of the systems being evaluated. The user must type in the utility scores for each system under evaluation, leaving spaces between the numbers. This process is continued until the final criterion is reached.

When "Load Weights" is selected, the computer will print out the current importance weights assigned to the criteria. Those will be all zeroes for a new model. The user must input the correct weights assigned to the various criteria comprising each node. Once the relative weights have been input, the computer normalizes them to sum to 100% and requests confirmation of the result. Once confirmation is given, the computer proceeds to the next node.

Print Data Sheet - The "Print Data Sheet" function allows the user to obtain a printout of the entire model for use in recording and entering weights and scores which are not available or finalized when the model is first created. It acts as a convenient recording device when an individual or group is arriving at the weights and scores. It clearly displays the entire model structure so that the user can note each criterion's relationship to the whole.

When this function is selected, the computer will inform the user how to obtain a printed output from the computer system on which EVAL is implemented.

# 6.0 AN EXAMPLE OF THE USE OF EVAL

This section presents an example evaluation procedure conducted using the EVAL system. The example is based on a hypothetical problem which involves choosing one of five candidate aircraft. The evaluation is based on more than thirty distinct criteria.

## 6.1 Hypothetical Problem

A DoD agency is investigating purchasing an executive aircraft in order to promote cost-effective and timely travel by its senior executive staff, both military and civilian. The agency has narrowed the choice of aircraft to five, which will hereafter be referred to as aircraft A, B, C, D, and E. The director of the agency has identified three major (highest level) selection criteria: cost, performance, and miscellaneous factors.

Each of the five aircraft is very attractive on one or two of the criteria; no single aircraft provides maximum benefit on all three criteria. Faced with a very difficult choice, the director has decided to use EVAL as a decision aid.

## 6.2 The Approach

The first step in using EVAL is to formulate a hierarchical evaluation structure: to add specificity by decomposing the three highest level criteria into their components. This step should be performed through normal working procedures; it does not require the use of the EVAL software.

Assume that after several hours, agreement was reached on the structural format shown in Figure 6-1. Note that the three highest level criteria have been successively decomposed to produce twenty-seven bottom-level criteria.

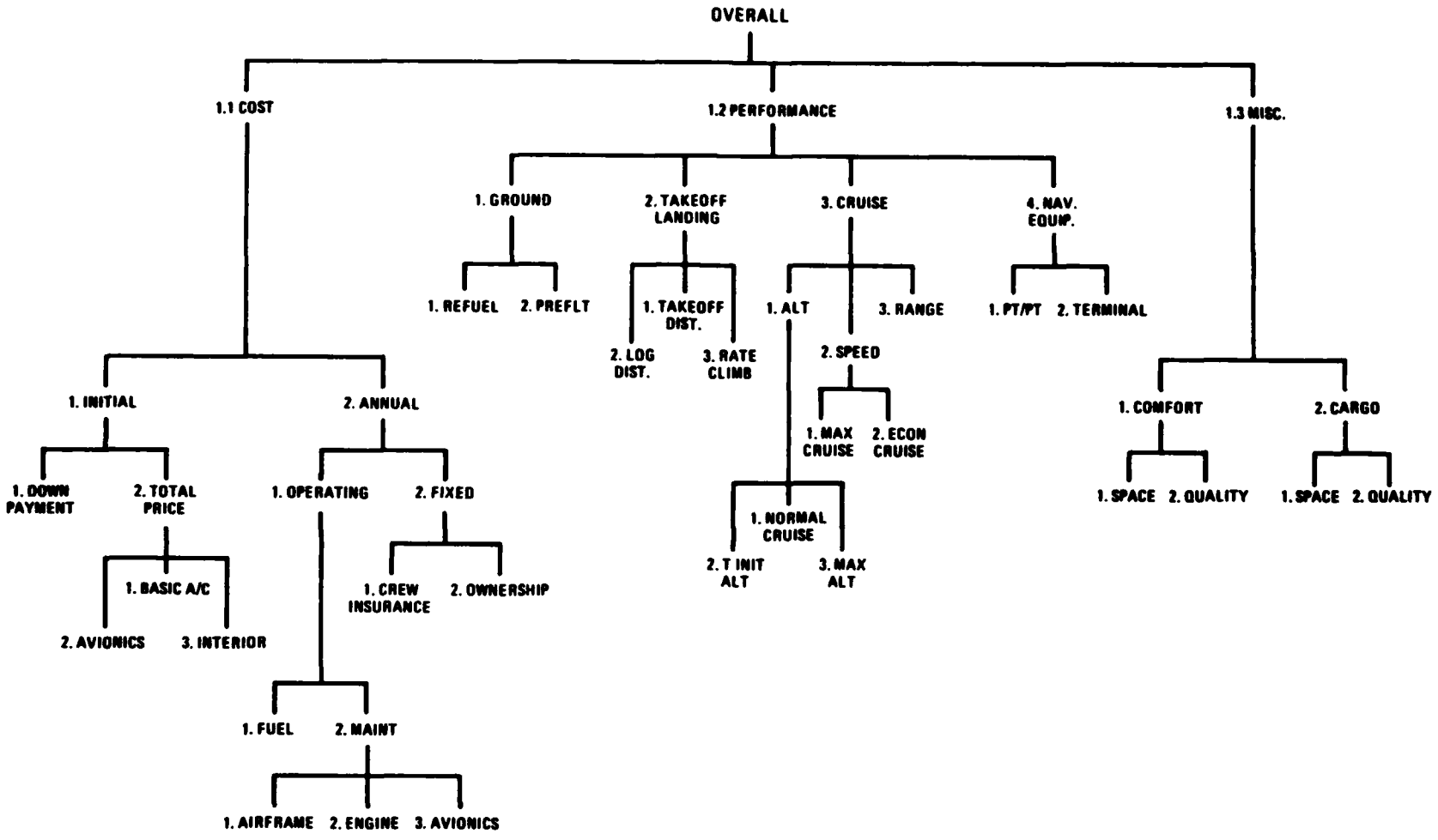


Figure 6-1

**EVALUATION STRUCTURE**

Having reached initial agreement on the structure, the user is now ready to use the EVAL software system. Since a brand new model is to be created, the user begins by loading the STRUCTURE subsystem of EVAL into the computer.

The remainder of the figures in this section include representative user inputs and corresponding system outputs. Other input formats would be equally suitable.

## 6.3 Using the STRUCTURE Software to Structure the Example Problem

Having loaded the STRUCTURE software, the user will observe a menu of options such as the one shown in Figure 6-2. In this and all succeeding figures, user inputs are underlined for clarity.

```
SELECT THE NUMBER OF THE OPTION YOU DESIRE
     1)  LOAD MODEL
     2)  EDIT STRUCTURE
     3)  CREATE OR ADD TO A STRUCTURE
     4)  SAVE MODEL
     5)  DEVELOP STRUCTURE
     6)  CREATE BRANCH
     7)  PRUNE SECTION
     8)  PRINT REVIEW SHEET
SELECTION:  6
```

Figure 6-2
STRUCTURE--THE PRIMARY MENU

For illustrative purposes, assume that the user has decided to construct the evaluation model in two stages: first, by creating two separate branches--one extending from criterion 1.1 (COST) and one extending from criterion 1.3

(MISC); and second, by creating the remainder of the structure and then adding the branches. Branches are created by selecting the "Create Branch" function.

When "Create Branch" is selected, the computer requests the branch identification number and then asks what type of branch, symmetric or asymmetric, is to be constructed. Note that in Figure 6-1, the COST branch is asymmetric and the MISC branch is symmetric, the symmetry referring to the repetition of the lower-level criteria. The exchange takes place as shown in Figure 6-3 for the COST branch. Note that the branch identification number is arbitrary.

```
ENTER THE BRANCH IDENTIFICATION NUMBER:  1
IS THIS A NEW BRANCH?  YES
IS THIS A SYMMETRIC BRANCH?  NO
```

Figure 6-3
DEFINING THE BRANCH NUMBER AND TYPE

The user will now be asked to enter the branch criteria, one at a time. The process proceeds as shown in Figure 6-4.

Having constructed the COST branch, the user continues by creating the MISC branch. That exchange is shown in Figure 6-5. Note that the second-level criteria are attached automatically to all of the first-level criteria. Similarly, if there were third-level criteria they would be attached to all of the second-level criteria.

```
ENTER THE CRITERIA, 1 PER LINE, AFTER THE "#" SIGN.
THE DIN MUST BE SEPARATED FROM THE CRITERION NAME BY A COMMA.
THE CRITERION NAME IS LIMITED TO 10 CHARACTERS AND MUST
CONTAIN NO COMMAS.

     #:1,INITIAL
     #:2,ANNUAL
     #:1.1,DOWN PAY
     #:1.2,TOT. PRICE
     #:1.2.1,BASIC ACFT
     #:1.2.2,AVIONICS
     #:1.2.3,INTERIOR
     #:2.1,OPERATING
     #:2.2,FIXED
     #:2.1.1,FUEL
     #:2.1.2,MAINT.
     #:2.1.2.1,AIRFRAME
     #:2.1.2.2,ENGINE
     #:2.1.2.3,AVIONICS
     #:2.2.1,CREW-INS.
     #:2.2.2,OWNERSHIP
     #:
```

Figure 6-4

CONSTRUCTING THE "COST" BRANCH

```
ENTER THE BRANCH IDENTIFICATION NUMBER:  2
IS THIS A NEW BRANCH?  YES
IS THIS A SYMMETRIC BRANCH?  YES
HOW MANY LEVELS ARE TO APPEAR IN THIS BRANCH?  2

ENTER THE LABELS FOR LEVEL 1, LIMITED TO 10 CHARACTERS AND
CONTAINING NO COMMAS:
     1)  COMFORT
     2)  CARGO
     3)

ENTER THE LABELS FOR LEVEL 2, LIMITED TO 10 CHARACTERS AND
CONTAINING NO COMMAS:
     1)  SPACE
     2)  QUALITY
     3)

ENTER THE BRANCH IDENTIFICATION NUMBER:
```

Figure 6-5

CONSTRUCTING A SYMMETRIC BRANCH

Having constructed the COST and MISC branches, the user now constructs the remainder of the evaluation structure using the "Create or Add to a Structure" function. Note that the entire structure could have been created using this function alone. The branches were created separately only to illustrate the use of the branch function. Note also how the two branches are attached to the structure. The process is shown in Figure 6-6.

Assume that after a lapse of time the user decides that the miscellaneous criterion is insufficiently detailed and should be expanded. Assume that the user has decided to replace it with an entirely new branch entitled INTERIOR, as shown in Figure 6-7.

To modify the existing structure, the user must first remove (prune) the portion of the structure that currently exists under criterion 1.3, MISC. The pruning process is shown in Figure 6-8.

Note that criterion 1.3, MISC, itself has not been removed from the structure, only the six lower-level criteria attached to it have been removed. Since the user wants to change the name of criterion 1.3 from MISC to INTERIOR, the user invokes the "Edit Structure" function. That process is shown in Figure 6-9.

Note also that the "Edit Structure" function can be used to remove a criterion from the structure. The process is identical to that shown in Figure 6-9 except that blank spaces are entered for the node label.

```
SELECTION:  3
IS THIS A NEW MODEL?  YES
ENTER THE LABELS FOR THE SYSTEMS TO BE EVALUATED,
ONE PER LINE, LIMITED TO 3 CHARACTERS.
     1)  A
     2)  B
     3)  C
     4)  D
     5)  E
     6)

ENTER THE CRITERIA, 1 PER LINE, AFTER THE "#" SIGN.  THE
DIN MUST BE SEPARATED FROM THE CRITERION NAME BY A COMMA.
THE CRITERION NAME IS LIMITED TO 10 CHARACTERS AND MUST
CONTAIN NO COMMAS.

     #:1,AIRCRAFT
     #:1.1,COST
     #:1.2,PERFORMANC
     #:1.3,MISC
     #:*BRANCH 1 TO 1.1
     #:1.2.1,GROUND
     #:1.2.2,TKOFF/LAND
     #:1.2.3,CRUISE
     #:1.2.4,NAV EQUIP
     #:1.2.1.1,REFUEL
     #:1.2.1.2,PRFLT
     #:1.2.2.1,TKOFF/DIS
     #:1.2.2.2,LAND/DIS
     #:1.2.2.3,RATE OF CL
     #:1.2.3.1,ALTITUDE
     #:1.2.3.2,SPEED
     #:1.2.3.3,RANGE+45MN
     #:1.2.3.1.1,NORM CRUIS
     #:1.2.3.1.2,T INIT ALT
     #:1.2.3.1.3,MAX ALT
     #:1.2.3.2.1,MAX CRUISE
     #:1.2.3.2.2,ECON CRUIS
     #:1.2.4.1,PT. TO PT.
     #:1.2.4.2,TERMINAL
     #:*BRANCH 2 TO 1.3
     #:
```

**Figure 6-6**

**CREATING THE MODEL**

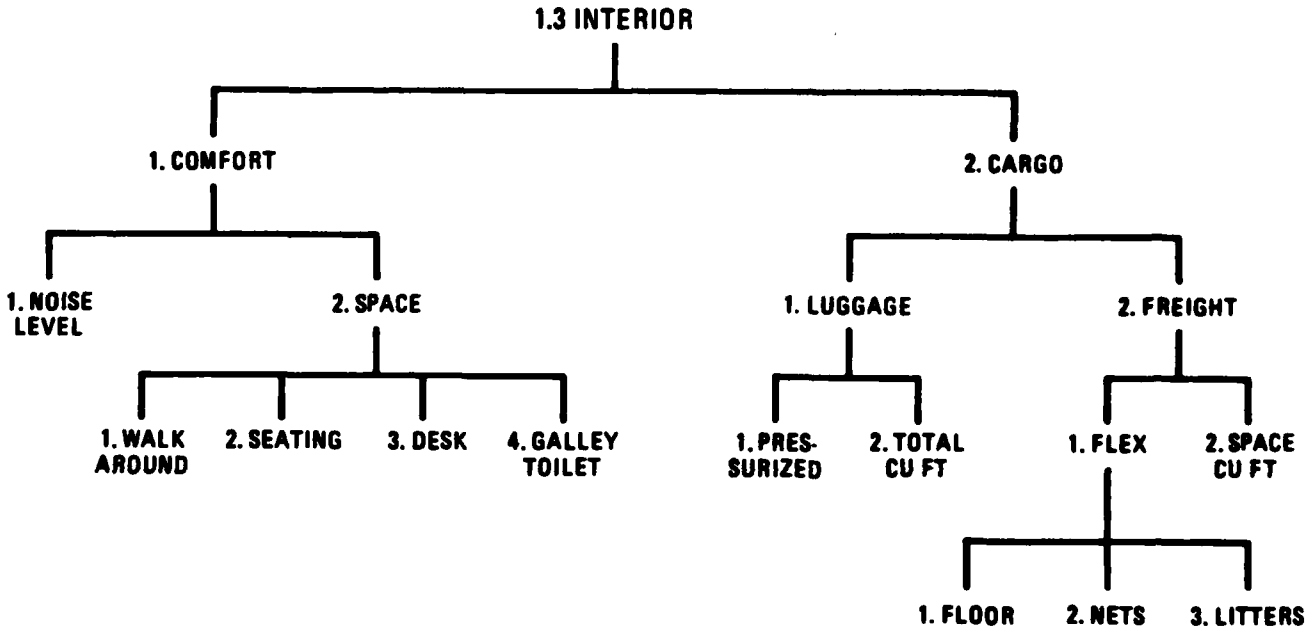


Figure 6-7
**INTERIOR CRITERIA**

```
SELECTION:  7
     ***** PRUNE SECTION *****
ENTER DIN OF SECTION TO BE PRUNED:  1.3
ALL NODES AFTER THE FOLLOWING WILL BE ERASED

     1.3  MISC

IS THAT CORRECT?  YES
6 NODES HAVE BEEN REMOVED.

ENTER DIN OF SECTION TO BE PRUNED:
```

Figure 6-8

PRUNING THE STRUCTURE

```
SELECTION:  2
     ***** EDIT STRUCTURE *****
ENTER DIN OF NODE TO BE EDITED:  1.3

     1.3  MISC

EDITED NODE:

     1.3  INTERIOR

ENTER DIN OF NODE TO BE EDITED:
```

Figure 6-9

CHANGING A NODE USING "EDIT STRUCTURE"

```
ENTER THE CRITERIA, 1 PER LINE, AFTER THE "#" SIGN.
THE DIN MUST BE SEPARATED FROM THE CRITERION NAME BY A COMMA.
THE CRITERION NAME IS LIMITED TO 10 CHARACTERS AND MUST
CONTAIN NO COMMAS.

#:1.3.1,COMFORT
#:1.3.2,CARGO
#:1.3.1.1,NOISE LEVEL
#:1.3.1.2,SPACE
#:1.3.1.2.1,WALK ARND
#:1.3.1.2.2,SEATING
#:1.3.1.2.3,DESK
#:1.3.1.2.4,GAL/TOILET
#:1.3.2.1,LUGGAGE
#:1.3.2.2,FREIGHT
#:1.3.2.1.1,PRESURIZED
#:1.3.2.1.2,TOT CU FT
#:1.3.2.2.1,FLEXIBLTY
#:1.3.2.2.2,SPACE/DUFT
#:1.3.2.2.1.1,FLOOR
#:1.3.2.2.1.2,NETS
#:1.3.2.2.1.3,LITTERS
#:
```

Figure 6-10
ADDING TO THE STRUCTURE

Before saving the newly created model, the user may wish to examine the computer version of the structure to ensure that all of the desired nodes exist and that all of the undesired nodes have been removed. It is also wise to check the structure before calling "Edit Structure" to determine what changes need to be made. In both cases, the user selects "Print Review Sheet" and receives a printed listing of the model structure. When "Print Review Sheet" is selected, the computer instructs the user how to activate the printer in order to obtain the hard copy. Figure 6-11 depicts this display.

SELECTION: 8

PRESS RED BUTTON ON PRINTER TO TURN IT ON.
ALIGN PAPER AND RETURN CARRIAGE TO OBTAIN HARD COPY.

1 AIRCRAFT
1.1 COST
1.1.1 INITIAL
1.1.1.1 DOWN PAY
1.1.1.2 TOT. PRICE
1.1.1.2.1 BASIC ACFT
1.1.1.2.2 AVIONICS
1.1.1.2.3 INTERIOR
1.1.2 ANNUAL
1.1.2.1 OPERATING
1.1.2.1.1 FUEL
1.1.2.1.2 MAINT.
1.1.2.1.2.1 AIRFRAME
1.1.2.1.2.2 ENGINE
1.1.2.1.2.3 AVIONICS
1.1.2.2 FIXED
1.1.2.2.1 CREW-INS.
1.1.2.2.2 OWNERSHIP
1.2 PERFORMANC
1.2.1 GROUND
1.2.1.1 REFUEL
1.2.1.2 PRFLT/STRT
1.2.2 TKOFF/LAND
1.2.2.1 TKOFF/DIS
1.2.2.2 LAND/DIS
1.2.2.3 RATE OF CL
1.2.3 CRUISE
1.2.3.1 ALTITUDE
1.2.3.1.1 NORM CRUIS
1.2.3.1.2 T INIT ALT
1.2.3.1.3 MAX ALT
1.2.3.2 SPEED
1.2.3.2.1 MAX CRUISE
1.2.3.2.2 ECON CRUISE
1.2.3.3 RANGE+45MN
1.2.4 NAV EQUIP
1.2.4.1 PT. TO PT.
1.2.4.2 TERMINAL
1.3 INTERIOR
1.3.1 COMFORT
1.3.1.1 NOISE LEVL

Figure 6-11
PRINT REVIEW SHEET

```
1.3.1.2  SPACE
1.3.1.2.1  WALK ARND
1.3.1.2.2  SEATING
1.3.1.2.3  DESK
1.3.1.2.4  GAL/TOILET
1.3.2  CARGO
1.3.2.1  LUGGAGE
1.3.2.1.1  PRESURIZED
1.3.2.1.2  TOT CU FT
1.3.2.2  FREIGHT
1.3.2.2.1  FLEXIBLTY
1.3.2.2.1.1  FLOOR
1.3.2.2.1.2  NETS
1.3.2.2.1.3  LITTERS
1.3.2.2.2  SPACE/CUFT

PRESS RED BUTTON TO TURN OFF PRINTER.
RETURN CARRIAGE TO RETURN TO PRIMARY MENU.
```

Figure 6-11 (Continued)
PRINT REVIEW SHEET

Before permanently saving the model, the user must first select "Develop Structure." This function allows the computer to organize the structure into a proper internal format for saving the model; a structure must be developed if the model is to be saved. Selecting "Develop Structure" produces an exchange similar to that shown in Figure 6-12.

```
SELECTION:  5
A ROUGH ESTIMATE OF THE TIME REQUIRED TO DEVELOP
THE STRUCTURE IS 2 MINUTES AND 30 SECONDS.

STRUCTURE HAS BEEN DEVELOPED.
PLEASE RETURN CARRIAGE TO CONTINUE.
```

Figure 6-12
DEVELOPING THE STRUCTURE

Once the structure is developed, the model can be saved. Figure 6-13 depicts a typical exchange when "Save Model" is selected.

```
SELECTION:  4
HAVE YOU DEVELOPED THE STRUCTURE?  YES
CURRENT MODELS:
     PERSONNEL
     RADIOS

ENTER THE MODEL NAME:  AIRCRAFT
```

Figure 6-13
SAVING A NEW MODEL

When the user has finished building and saving a new model, there may be a need to edit a previously constructed model. "Load Model" may be used to load an existing model into the computer workspace. Figure 6-14 depicts this process. The computer will then load the desired model and return once again to the primary menu.

```
SELECTION:  1
SELECT THE NUMBER OF THE OPTION YOU DESIRE.
CURRENT MODELS:
     1)  PERSONNEL
     2)  RADIOS
     3)  AIRCRAFT
SELECTION:  1
```

Figure 6-14
LOADING A MODEL

To stop processing, the user must return the carriage without typing anything when faced with the primary menu. Figure 6-15 depicts this process.

```
SELECT THE NUMBER OF THE OPTION YOU DESIRE:
     1)  LOAD MODEL
     2)  EDIT STRUCTURE
     3)  CREATE OR ADD TO A STRUCTURE
     4)  SAVE MODEL
     5)  DEVELOP STRUCTURE
     6)  CREATE BRANCH
     7)  PRUNE SECTION
     8)  PRINT REVIEW SHEET
SELECTION:
ANY CHANGES MADE DURING THIS SESSION ARE NOT PERMANENT
UNLESS YOU SAVED THE MODEL.
DO YOU WISH TO STOP?  YES
```

Figure 6-15
STOPPING THE PROGRAM

Having structured the aircraft evaluation model, the user must now enter utility scores and criteria weights. That is done by using the RUN subsystem.

## 6.4 Using the RUN Subsystem to Input Values and View the Results of the Example Problem

Having loaded the RUN program, the user will be asked to load a model. No other RUN functions can be performed until a model is loaded. A model is loaded as shown in Figure 6-16.

```
THE RUN SOFTWARE PROGRAM HAS BEEN LOADED.
SELECT THE NUMBER OF THE OPTION YOU DESIRE.
CURRENT MODELS:
     1)  PERSONNEL
     2)  RADIOS
     3)  AIRCRAFT
SELECTION:  3
```

Figure 6-16

LOADING A MODEL FOR USE WITH EVAL

The computer will now display the primary RUN menu, as shown in Figure 6-17.

```
SELECT THE NUMBER OF THE OPTION YOU DESIRE.
     1)  DISPLAY RESULTS
     2)  SENSITIVITY
     3)  EDIT VALUES
     4)  PRINT RESULTS
     5)  LOAD MODEL
     6)  SAVE MODEL
     7)  NEW VALUES
     8)  PRINT DATA SHEET
SELECTION:
```

Figure 6-17

EVAL--THE PRIMARY MENU

In order to obtain a convenient format for recording utility scores and criterion weights, the user should select the "Print Data Sheet" option. The computer will describe how to obtain a printed data sheet and one will be produced. The exchange might be similar to that shown in Figure 6-18.

```
SELECTION:  8
PRESS RED BUTTON ON PRINTER TO TURN IT ON.
ALIGN PAPER AND RETURN CARRIAGE TO OBTAIN HARD COPY.

                                                    A     B     C     D     E
1. - AIRCRAFT
1.1. - COST    (WT:___)
1.1.1. - INITIAL    (WT:___)
1.1.1.1. - DOWN PAY    (WT:___)                    ___   ___   ___   ___   ___
1.1.1.2. - TOT. PRICE  (WT:___)
1.1.1.2.1. - BASIC ACFT    (WT:___)                ___   ___   ___   ___   ___
1.1.1.2.2. - AVIONICS      (WT:___)                ___   ___   ___   ___   ___
1.1.1.2.3. - INTERIOR      (WT:___)                ___   ___   ___   ___   ___
1.1.2. - ANNUAL    (WT:___)
1.1.2.1. - OPERATING    (WT:___)
1.1.2.1.1. - FUEL    (WT:___)                      ___   ___   ___   ___   ___
1.1.2.1.2. - MAINT.  (WT:___)
1.1.2.1.2.1. - AIRFRAME    (WT:___)                ___   ___   ___   ___   ___
1.1.2.1.2.2. - ENGINE      (WT:___)                ___   ___   ___   ___   ___
1.1.2.1.2.3. - AVIONICS    (WT:___)                ___   ___   ___   ___   ___
1.1.2.2. - FIXED    (WT:___)
1.1.2.2.1. - CREW-INS    (WT:___)                  ___   ___   ___   ___   ___
1.1.2.2.2. - OWNERSHIP   (WT:___)                  ___   ___   ___   ___   ___
1.2. - PERFORMANC    (WT:___)
1.2.1. - GROUND    (WT:___)
1.2.1.1. - REFUEL       (WT:___)                   ___   ___   ___   ___   ___
1.2.1.2. - PRFLT/STRT   (WT:___)                   ___   ___   ___   ___   ___
1.2.2. - TKOFF/LAND    (WT:___)
1.2.2.1. - TKOFF/DIS    (WT:___)                   ___   ___   ___   ___   ___
1.2.2.2. - LAND/DIS      (WT:___)                  ___   ___   ___   ___   ___
1.2.2.3. - RATE OF CL    (WT:___)                  ___   ___   ___   ___   ___
1.2.3. - CRUISE    (WT:___)
1.2.3.1 - ALTITUDE    (WT:___)
1.2.3.1.1. - NORM CRUIS    (WT:___)                ___   ___   ___   ___   ___
1.2.3.1.2. - T INIT ALT    (WT:___)                ___   ___   ___   ___   ___
1.2.3.1.3. - MAX ALT       (WT:___)                ___   ___   ___   ___   ___
1.2.3.2. - SPEED    (WT:___)
1.2.3.2.1. - MAX CRUISE    (WT:___)                ___   ___   ___   ___   ___
1.2.3.2.2. - ECON CRUIS    (WT:___)                ___   ___   ___   ___   ___
1.2.3.3. - RANGE+45MN    (WT:___)                  ___   ___   ___   ___   ___
1.2.4. - NAV EQUIP    (WT:___)
1.2.4.1. - PT. TO PT.    (WT:___)                  ___   ___   ___   ___   ___
1.2.4.2. - TERMINAL      (WT:___)                  ___   ___   ___   ___   ___
1.3. - INTERIOR    (WT:___)
1.3.1. - COMFORT    (WT:___)
1.3.1.1. - NOISE LEVL    (WT:___)                  ___   ___   ___   ___   ___
1.3.1.2. - SPACE         (WT:___)
1.3.1.2.1. - WALK ARND    (WT:___)                 ___   ___   ___   ___   ___
1.3.1.2.2. - SEATING      (WT:___)                 ___   ___   ___   ___   ___
```

Figure 6-18

OBTAINING A WORK SHEET

```
1.3.1.2.3. - DESK          (WT:___)
1.3.1.2.4. - GAL/TOILET    (WT:___)
1.3.2. - CARGO    (WT:___)
1.3.2.1. - LUGGAGE    (WT:___)
1.3.2.1.1. - PRESURIZED    (WT:___)
1.3.2.1.2. - TOT CU FT     (WT:___)
1.3.2.2. - FREIGHT    (WT:___)
1.3.2.2.1. - FLEXIBLTY    (WT:___)
1.3.2.2.1.1. - FLOOR      (WT:___)
1.3.2.2.1.2. - NETS       (WT:___)
1.3.2.2.1.3. - LITTERS    (WT:___)
1.3.2.2.2. - SPACE/CUFT    (WT:___)

PRESS RED BUTTON TO TURN OFF PRINTER.
RETURN CARRIAGE TO RETURN TO PRIMARY MENU.
```

Figure 6-18 (Continued)
OBTAINING A WORKSHEET

The "New Values" function will allow those assessed values to be input to the model. Selecting "New Values" yields a secondary menu, as shown in Figure 6-19.

```
SELECTION:  7
SELECT THE NUMBER OF THE OPTION YOU DESIRE.
     1)  LOAD SCORES
     2)  LOAD WEIGHTS
SELECTION:  1
```

Figure 6-19
SECONDARY MENU UNDER "NEW VALUES"

When "Load Scores" is selected, the computer prints out the model criteria line by line, in order by DIN, stopping for user input of scores whenever a bottom-level criterion is reached. A utility score must be input for each of the five aircraft being evaluated. Figure 6-20 displays how this

interchange might appear. When the user has finished inputting the scores, the computer will return to the secondary menu.

SELECTION: 1

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1. - AIRCRAFT | | | | | |
| 1.1. - COST | | | | | |
| 1.1.1. - INITIAL | | | | | |
| 1.1.1.1. - DOWN PAY | 75 | 0 | 50 | 85 | 100 |
| 1.1.1.2. - TOT. PRICE | | | | | |
| 1.1.1.2.1. - BASIC ACFT | 70 | 0 | 50 | 80 | 100 |
| 1.1.1.2.2. - AVIONICS | 60 | 75 | 100 | 30 | 0 |
| 1.1.1.2.3. - INTERIOR | 60 | 100 | 70 | 30 | 0 |
| 1.1.2. - ANNUAL | | | | | |
| 1.1.2.1. - OPERATING | | | | | |
| 1.1.2.1.1. - FUEL | 75 | 40 | 0 | 80 | 100 |
| 1.1.2.1.2. - MAINT. | | | | | |
| 1.1.2.1.2.1. - AIRFRAME | 60 | 0 | 45 | 100 | 80 |
| 1.1.2.1.2.2. - ENGINE | 50 | 60 | 0 | 80 | 100 |
| 1.1.2.1.2.3. - AVIONICS | 75 | 0 | 55 | 100 | 80 |
| 1.1.2.2. - FIXED | | | | | |
| 1.1.2.2.1. - CREW-INS | 60 | 0 | 60 | 100 | 80 |
| 1.1.2.2.2. - OWNERSHIP | 70 | 0 | 40 | 100 | 85 |
| 1.2. - PERFORMANC | | | | | |
| 1.2.1. - GROUND | | | | | |
| 1.2.1.1. - REFUEL | 100 | 0 | 60 | 80 | 80 |
| 1.2.1.2. - PRFLT/STRT | 80 | 100 | 0 | 40 | 50 |
| 1.2.2. - TKOFF/LAND | | | | | |
| 1.2.2.1. - TKOFF/DIS | 60 | 0 | 55 | 70 | 100 |
| 1.2.2.2. - LAND/DIS | 75 | 75 | 0 | 80 | 100 |
| 1.2.2.3. - RATE OF CL | 50 | 100 | 95 | 0 | 60 |
| 1.2.3. - CRUISE | | | | | |
| 1.2.3.1. - ALTITUDE | | | | | |
| 1.2.3.1.1. - NORM CRUIS | 75 | 95 | 100 | 0 | 30 |
| 1.2.3.1.2. - T INIT ALT | 65 | 90 | 100 | 0 | 35 |
| 1.2.3.1.3. - MAX ALT | 75 | 100 | 95 | 0 | 30 |
| 1.2.3.2. - SPEED | | | | | |
| 1.2.3.2.1. - MAX CRUISE | 70 | 100 | 85 | 0 | 35 |
| 1.2.3.2.2. - ECON CRUIS | 70 | 100 | 85 | 0 | 30 |
| 1.2.3.3. - RANGE+45MN | 60 | 100 | 70 | 0 | 70 |

Figure 6-20
LOADING SCORES

| | | | | | |
|---|---|---|---|---|---|
| 1.2.4. - NAV EQUIP | | | | | |
| 1.2.4.1. - PT. TO PT. | 60 | 100 | 80 | 40 | 0 |
| 1.2.4.2. - TERMINAL | 75 | 100 | 85 | 0 | 45 |
| 1.3. - INTERIOR | | | | | |
| 1.3.1. - COMFORT | | | | | |
| 1.3.1.1. - NOISE LEVL | 50 | 100 | 70 | 0 | 45 |
| 1.3.1.2. - SPACE | | | | | |
| 1.3.1.2.1. - WALK ARND | 40 | 70 | 0 | 100 | 70 |
| 1.3.1.2.2. - SEATING | 75 | 100 | 0 | 50 | 65 |
| 1.3.1.2.3. - DESK | 75 | 100 | 50 | 0 | 80 |
| 1.3.1.2.4. - GAL/TOILET | 0 | 100 | 85 | 40 | 60 |
| 1.3.2. - CARGO | | | | | |
| 1.3.2.1. - LUGGAGE | | | | | |
| 1.3.2.1.1. - PRESURIZED | 50 | 100 | 40 | 0 | 85 |
| 1.3.2.1.2. - TOT CU FT | 40 | 100 | 0 | 70 | 80 |
| 1.3.2.2. - FREIGHT | | | | | |
| 1.3.2.2.1. - FLEXIBLTY | | | | | |
| 1.3.2.2.1.1. - FLOOR | 0 | 40 | 50 | 80 | 100 |
| 1.3.2.2.1.2. - NETS | 100 | 40 | 0 | 25 | 70 |
| 1.3.2.2.1.3. - LITTERS | 0 | 50 | 30 | 75 | 100 |
| 1.3.2.2.2. - SPACE/CUFT | 0 | 100 | 60 | 40 | 65 |

Figure 6-20 (Continued)
LOADING SCORES

The "Load Weights" function allows the user to input the relative weights of the criteria branching from each node. The computer presents the criteria to the user, one by one, in order by DIN, requesting the relative weights of the successive criteria and requesting confirmation for the normalized values. The process might proceed as shown in Figure 6-21.

After the final weights have been input and confirmed, the computer returns the user to the secondary menu. The user may then return the carriage without selecting either "Load Weights" or "Load Scores" to return to the primary menu.

SELECTION: 2

1 AIRCRAFT

| | COST | PERFORMANCE | INTERIOR |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 6 | 10 | 4 |
| NORMALIZED | 30 | 50 | 20 |

IF THESE ARE CORRECT TYPE GO:

| | | | |
|---|---|---|---|
| NEW WTS: | 6 | 11 | 3 |
| NORMALIZED: | 30 | 55 | 15 |

IF THESE ARE CORRECT TYPE GO: GO

1.1 COST

| | INITIAL | ANNUAL |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 35 | 65 |
| NORMALIZED: | 35 | 65 |

IF THESE ARE CORRECT TYPE GO: GO

1.1.1 INITIAL

| | DOWN PAY | TOT. PRICE |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 2 | 3 |
| NORMALIZED: | 40 | 60 |

IF THESE ARE CORRECT TYPE GO: GO

1.1.1.2 TOT. PRICE

| | BASIC ACFT | AVIONICS | INTERIOR |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 60 | 15 | 25 |
| NORMALIZED: | 60 | 15 | 25 |

IF THESE ARE CORRECT TYPE GO: GO

1.1.2 ANNUAL

| | OPERATING | FIXED |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 1 | 1 |
| NORMALIZED: | 50 | 50 |

IF THESE ARE CORRECT TYPE GO: GO

Figure 6-21

INPUTTING WEIGHTS

1.1.2.1 OPERATING

| | FUEL | MAINT. |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 1 | 1 |
| NORMALIZED: | 50 | 50 |

IF THESE ARE CORRECT TYPE GO: GO

1.1.2.1.2 MAINT.

| | AIRFRAME | ENGINE | AVIONICS |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 25 | 45 | 30 |
| NORMALIZED: | 25 | 45 | 30 |

IF THESE ARE CORRECT TYPE GO: GO

1.1.2.2 FIXED

| | CREW-INS | OWNERSHIP |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 3 | 7 |
| NORMALIZED: | 30 | 70 |

IF THESE ARE CORRECT TYPE GO: GO

1.2 PERFORMANC

| | GROUND | TKOFF/LAND | CRUISE | NAV EQUIP |
|---|---|---|---|---|
| CURRENT: | 0 | 0 | 0 | 0 |
| NEW WTS: | 10 | 40 | 35 | 15 |
| NORMALIZED: | 10 | 40 | 35 | 15 |

IF THESE ARE CORRECT TYPE GO: GO

1.2.1 GROUND

| | REFUEL | PRFLT/STRT |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 3 | 7 |
| NORMALIZED: | 30 | 70 |

IF THESE ARE CORRECT TYPE GO: GO

1.2.2 TKOFF/LAND

| | TKOFF/DIS | LAND/DIS | RATE OF CL |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 3 | 5 | 2 |
| NORMALIZED: | 30 | 50 | 20 |

IF THESE ARE CORRECT TYPE GO: GO

Figure 6-21 (Continued)
INPUTTING WEIGHTS

1.2.3 CRUISE

| | ALTITUDE | SPEED | RANGE+45MN |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 2 | 3 | 5 |
| NORMALIZED: | 20 | 30 | 50 |

IF THESE ARE CORRECT TYPE GO: GO

1.2.3.1 ALTITUDE

| | NORM CRUIS | T INIT ALT | MAX ALT |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 6 | 3 | 1 |
| NORMALIZED: | 60 | 30 | 10 |

IF THESE ARE CORRECT TYPE GO: GO

1.2.3.2 SPEED

| | MAX CRUISE | ECON CRUISE |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 35 | 65 |
| NORMALIZED: | 35 | 65 |

IF THESE ARE CORRECT TYPE GO: GO

1.2.4 NAV EQUIP

| | PT. TO PT. | TERMINAL |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 2 | 3 |
| NORMALIZED: | 40 | 60 |

IF THESE ARE CORRECT TYPE GO: GO

1.3 INTERIOR

| | COMFORT | CARGO |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 4 | 1 |
| NORMALIZED: | 80 | 20 |

IF THESE ARE CORRECT TYPE GO: GO

1.3.1 COMFORT

| | NOISE LEVL | SPACE |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 3 | 2 |
| NORMALIZED: | 60 | 40 |

IF THESE ARE CORRECT TYPE GO: GO

Figure 6-21 (Continued)
INPUTTING WEIGHTS

1.3.1.2 SPACE

| | WALK ARND | SEATING | DESK | GAS/TOILET |
|---|---|---|---|---|
| CURRENT: | 0 | 0 | 0 | 0 |
| NEW WTS: | 5 | 10 | 3 | 2 |
| NORMALIZED: | 25 | 50 | 15 | 10 |

IF THESE ARE CORRECT TYPE GO: GO

1.3.2 CARGO

| | LUGGAGE | FREIGHT |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 7 | 3 |
| NORMALIZED: | 70 | 30 |

IF THESE ARE CORRECT TYPE GO: GO

1.3.2.2 FREIGHT

| | FLEXIBLTY | SPACE/CUFT |
|---|---|---|
| CURRENT: | 0 | 0 |
| NEW WTS: | 45 | 55 |
| NORMALIZED: | 45 | 55 |

IF THESE ARE CORRECT TYPE GO: GO

1.3.2.2.1 FLEXIBLTY

| | FLOOR | NETS | LITTERS |
|---|---|---|---|
| CURRENT: | 0 | 0 | 0 |
| NEW WTS: | 60 | 25 | 15 |
| NORMALIZED: | 60 | 25 | 15 |

IF THESE ARE CORRECT TYPE GO: GO

Figure 6-21 (Continued)
INPUTTING WEIGHTS

While reviewing the numbers that had been input, the user realized that several errors had been made while inputting the values. Therefore, "Edit Values" was selected, presenting the secondary menu depicted in Figure 6-22.

```
SELECTION:  3
SELECT THE NUMBER OF THE OPTION YOU DESIRE.
     1)  EDIT SCORES
     2)  EDIT WEIGHTS
SELECTION:  1
```

Figure 6-22
SECONDARY MENU BENEATH "EDIT VALUES"

Next, "Edit Scores" was selected and the process shown in Figure 6-23 occurred.

```
SELECTION:  1
     ***** EDIT SCORES *****
DIN TO BE EDITED:  1.2.1.1

1.2.1.1  REFUEL
                          A     B     C     D     E
       CURRENT SCORES:  100     0    60    80    80
       NEW SCORES:      100    60     0    80    80

DIN TO BE EDITED:
```

Figure 6-23
EDITING SCORES

Next, the "Edit Weights" function was selected and the exchange shown in Figure 6-24 ensued. The user eventually returns the carriage to signify that the editing of weights has been completed. This will place the user at the secondary menu. Returning the carriage without selecting either "Edit Scores" or "Edit Weights" returns the user to the primary menu.

```
SELECTION:  2
     ***** EDIT WEIGHTS *****
DIN TO BE EDITED:  1.1.2

1.1.2  ANNUAL
                          OPERATING       FIXED
            CURRENT:         50             50
            NEW WTS:          3              2
          NORMALIZED:        60             40

IF THESE ARE CORRECT TYPE GO:  GO

DIN TO BE EDITED:
```

Figure 6-24
EDITING WEIGHTS

In order to avoid losing the model inadvertently, now that values have been added to it, the user should immediately save the model. When "Save Model" is selected, an exchange similar to that shown in Figure 6-25 occurs. Once the model is saved, the computer will automatically return the user to the primary menu.

```
SELECTION:  6
     ***** SAVE MODEL *****
CURRENT MODELS
     PERSONNEL
     RADIOS
     AIRCRAFT
ENTER NAME OF NEW MODEL:  AIRCRAFT
A MODEL WITH THIS NAME ALREADY EXISTS.
DO YOU WISH TO REPLACE IT?  YES
```

Figure 6-25
SAVING A MODEL AFTER ENTERING VALUES

In order to view the results of the model, the user should select "Display Results." An exchange similar to that shown in Figure 6-26 might result.

```
SELECTION:  1
     ***** DISPLAY RESULTS *****
DIN TO BE DISPLAYED:  1

1    AIRCRAFT
     FACTOR              WT     A     B     C     D     E     CUMWT
     1)  COST          (30)    68    35    47    81    82     30.00%
     2)  PERFORMANC    (55)    68    81    69    47    64     55.00%
     3)  INTERIOR      (15)    52    91    55    43    60     15.00%
           TOTAL               66    68    61    57    69    100.00%

DIN TO BE DISPLAYED:  1.2
1.2  AIRCRAFT - PERFORMANCE
     FACTOR              WT     A     B     C     D     E     CUMWT
     1)  GROUND        (10)    85    81    27    52    59      5.50%
     2)  TKOFF/LAND    (40)    65    66    66    66    88     22.00%
     3)  CRUISE        (35)    65    91    80    32    51     19.25%
     4)  NAV EQUIP     (15)    69    94    83    31    35      8.25%
           TOTAL               68    81    69    47    64     55.00%

DIN TO BE DISPLAYED:
```

Figure 6-26
DISPLAY RESULTS

The user could examine each and every DIN if desired. Here, though, the user decided to examine more closely DIN "1.2 PERFORMANCE." The "Sensitivity" function was chosen in order to closely examine this factor.

Selecting "Sensitivity" causes the computer to request the DIN of the factor to be examined. The computer will then request the minimum and maximum cumulative weights to be considered. Scores for each alternative will be listed, assuming that the specified factor has anywhere between the

minimum and maximum cumulative weight (by increments of 10% of the difference between the highest and lowest cumulative weights considered). Figure 6-27 depicts the results of selecting "Sensitivity."

```
SELECTION:  2
***** SENSITIVITY *****
WHAT FACTOR DO YOU WISH TO EXAMINE?
ENTER DIN:  1.2

1.2  PERFORMANC
          CURRENT CUMWT:  55.00
          MINIMUM CUMWT:  0
          MAXIMUM CUMWT:  100

1.2  PERFORMANCE CURRENT CUMWT:  55.00
WEIGHT     A     B     C     D     E
   .0     63    54    50    68    74*
 10.0     63    56    52    66    73*
 20.0     64    59    54    64    72*
 30.0     64    62    56    62    71*
 40.0     65    64    58    60    70*
 50.0     65    67    60    58    69*
 60.0     66    70*   62    56    68
 70.0     66    72*   63    54    67
 80.0     67    75*   65    52    66
 90.0     67    78*   67    49    65
100.0     68    81*   69    47    64

WHAT FACTOR DO YOU WISH TO EXAMINE?
ENTER DIN:
```

Figure 6-27
SENSITIVITY

Note that aircraft E is optimal until "1.2 PERFORMANCE" receives about 50% of the cumulative weight; "1.2 PERFORMANCE" could be examined even more closely (and a threshold value obtained) by selecting and specifying minimum and maximum cumulative weights of 50% and 60%. In addition,

other sensitivity analyses could be performed for any of the individual criteria in the diagram.

Once the model has been displayed and sensitivity analyses performed, the user may wish to alter the model. "Edit Values" should be used if any permanent changes are desired. After the changes are made, the user must once again select "Save Model" to record these changes permanently.

Selecting "Print Results" will produce a printout of all matrices available through "Display Results," in order by DIN. Figure 6-28 demonstrates its use for the first three nodes only.

SELECTION: 4

PRESS RED BUTTON ON PRINTER TO TURN IT ON.
ALIGN PAPER AND RETURN CARRIAGE TO OBTAIN HARD COPY.

1. OVERALL

| | FACTOR | WT | A | B | C | D | E | CUMWT |
|---|---|---|---|---|---|---|---|---|
| 1) | COST | (30) | 68 | 32 | 47 | 81 | 82 | 30.00% |
| 2) | PERFORMANC | (55) | 68 | 81 | 69 | 47 | 64 | 55.00% |
| 3) | INTERIOR | (15) | 52 | 91 | 55 | 43 | 60 | 15.00% |
| | TOTAL | | 66 | 68 | 61 | 57 | 69 | 100.00% |

1.1. COST

| | FACTOR | WT | A | B | C | D | E | CUMWT |
|---|---|---|---|---|---|---|---|---|
| 1) | INITIAL | (35) | 70 | 25 | 56 | 70 | 75 | 10.50% |
| 2) | ANNUAL | (65) | 67 | 36 | 43 | 87 | 86 | 19.50% |
| | TOTAL | | 68 | 32 | 47 | 81 | 82 | 30.00% |

1.1.1. INITIAL

| | FACTOR | WT | A | B | C | D | E | CUMWT |
|---|---|---|---|---|---|---|---|---|
| 1) | DOWN PAY | *(40) | 75 | 0 | 50 | 85 | 100 | 4.20% |
| 2) | TOT. PRICE | (60) | 66 | 41 | 60 | 60 | 59 | 6.30% |
| | TOTAL | | 70 | 25 | 56 | 70 | 75 | 10.50% |

Figure 6-28
PRINT RESULTS

Having finished with the "AIRCRAFT" model, the user may wish to exercise another model. "Load Model" could be used to gain access to it. On the other hand, the user may wish to end the session. If so, the carriage should be returned without selecting an option from the primary menu. The computer will then remind the user that any changes made during the session will be saved only if "Save Model" has been selected. The computer then requests confirmation that the user is finished before actually terminating the program.

# 7.0 ABRIDGED USERS MANUAL

This section is designed for the user who is already familiar with EVAL. It describes the essential elements of the evaluation procedure, and discusses how those are molded into the multi-attribute utility model implemented by EVAL.

## 7.1 Structuring the Decision Problem

Every decision problem appropriate for EVAL includes the following elements:

- o A list of alternative systems to be evaluated;
- o An overall evaluation criterion; and
- o A hierarchical set of criteria intc which the overall criterion is decomposed.

Judgmental assessments which must be made include:

- o The relative importance weights of the criteria; and
- o The relative utility of each system evaluated at the bottom-level criteria.

Once the elements and assessments are specified, the user is ready to use the EVAL program.

## 7.2 Subsystems

EVAL consists of two subsystems: STRUCTURE and RUN. STRUCTURE is used to construct the model. RUN is used to enter values and weights and to display results.

7.2.1 Functions available in STRUCTURE - Once STRUCTURE is loaded into the computer, a menu of functions appears as follows:

- o Load Model
- o Edit Structure
- o Create or add to a Structure
- o Save Model
- o Develop Structure
- o Create Branch
- o Prune Section
- o Print Review Sheet.

The user must first either load an existing model or create a new one.

Selecting "Load Model" allows the user to load an existing model. Once a model is loaded, the user may select "Edit Structure" in order to edit the existing structure by changing the criteria names or data identification numbers (DINs), or by deleting single criteria. Selecting "Create or Add to a Structure" allows the user to change the model by adding new criteria. Whole sections of criteria may be deleted by using "Prune Section." Whole sections of criteria may be created using "Create Branch" (these must be added to the structure later using "Create or Add to a Structure"). After any changes are made, "Develop Structure" must be selected to properly format the model internally for saving. The model can then be saved using the

"Save Model" function. A printout can be obtained using "Print Review Sheet."

To create an entirely new model, the user selects "Create or Add to a Structure." The names of the alternative systems to be evaluated are typed in, and the DINs and criteria names are input one by one. Branches may be added if they have been previously created. Any necessary editing and pruning is done before the model is developed and saved. A printout may be obtained using "Print Review Sheet."

7.2.2 Options available in RUN - When RUN is loaded into the computer, the program will automatically ask the user to load a model from the model library. A menu of options will appear, as follows:

- o Display Results
- o Sensitivity
- o Edit Values
- o Print Results
- o Load Model
- o Save Model
- o New Values
- o Print Data Sheet.

Since a model has already been loaded from the model library, the user need not select "Load Model" to perform this function. "Load Model" may be used later to work on another problem.

The user should select "Print Data Sheet" to obtain a convenient form on which to assess and record scores and relative weights and to provide a record of the existing structure. If weights and scores have not been entered into the model, "New Values" must be selected in

order to accomplish that function. If any typographical errors were made in entering the data, "Edit Values" may be selected to correct them. If any additions or changes have been made to the data, the model should now be saved by using "Save Model."

Once the values have been correctly loaded into the model, the user may wish to examine the results. Selecting "Display Results" causes the computer to display the normalized weights, cumulative weights, and intermediate scores for the DIN designated by the user, and for the criteria directly attached to that DIN. The user may choose to examine any number of DINs. Once the user is satisfied, "Sensitivity" may be chosen to examine the threshold cumulative weight for any specific DIN. A threshold weight is the cumulative weight which causes a new system to replace the previously highest scoring system. Any number of DINs may be examined using "Sensitivity."

After examination of the model, the user may wish to permanently alter some of the weights and scores. If so, the "Edit Values" function should be requested and the changes made. The model should be saved, and a printout of the final results obtained by using the "Print Results" function which prints out, in order of DIN, all of the criterion matrices available in "Display Results." Another model may then be loaded for examination by using "Load Model" or the computer session may be terminated.